UCRL-JC-121455 Abs

Abstract for invited paper at the 7th International Symposium on Heavy Ion Inertial Fusion, Sept. 6-9, 1995, Princeton NJ

RECIRCULATING INDUCTION ACCELERATORS FOR INERTIAL FUSION: PROSPECTS AND STATUS*

A. Friedman†

Lawrence Livermore National Laboratory, L-440, Livermore CA 94550 USA

The U.S. Inertial Fusion Energy Program is developing the physics and technology of induction accelerators, toward the goal of electric power production via heavy-ion inertial fusion. The recirculating induction accelerator repeatedly passes beams through the same set of accelerating and focusing elements, thereby reducing both the length and gradient of the accelerator structure. This promises a very attractive driver cost, if the technical challenges associated with recirculation can be met.

Point designs for recirculator drivers were developed in a multi-year study by LLNL, LBL, and FM Technologies.[1] That work was presented at the previous Symposium and so is only briefly reviewed in this paper.

We present plans for and progress toward a small (4.5-m diameter) prototype recirculator which will accelerate a space-charge-dominated beam of K^+ ions through 15 laps, from 80 to 320 keV and from 2 to 8 mA. Transverse beam confinement is effected via permanent-magnet quadrupoles; bending is via electric dipoles. Scaling laws, and extensive particle and fluid simulations of the space-charge dominated beam behavior, have been used to arrive at the physics design. The dimensionless parameters of the beam dynamics were specifically chosen to resemble those of a driver, and the experiments should serve to validate major elements of the recirculator concept.

This "Small Recirculator" is being developed in a build-and-test sequence. An injector and matching section are operational. Initial experiments are investigating intense-beam transport in a linear magnetic channel using seven half-lattice periods of permanent-magnet quadrupole lenses. A mechanical design of the recirculator's half-lattice period is nearly complete as of this writing (May 1995).

Near-term plans include studies of space-charge-dominated beam transport around a bend. Later experiments will study insertion and extraction of the beam into and out of the ring, and acceleration with centroid control. The ultimate goal is demonstration of flexible recirculator operation.

---

[1] J. J. Barnard *et.al., Phys. Fluids B: Plasma Physics* **5**, 2698 (1993).

†Work performed in collaboration with J. J. Barnard, M. D. Cable, D. A. Callahan, F. J. Deadrick, D. P. Grote, V. P. Karpenko, H. C. Kirbie, S. M. Lund, L. A. Nattrass, M. B. Nelson, M. A. Newton, T. C. Sangster, and W. M. Sharp, *LLNL*; T. J. Fessenden and D. L. Judd, *LBL*; S. Eylon, *Titan Beta*; H. A. Hopkins, *U. C. Berkeley;* and D. B. Longinotti, *EG&G*

*Work performed under the auspices of the U.S. DOE by LLNL and LBL under contracts W-7405-ENG-48 and DE-AC03-76SF00098.